Review Paper: Power Quality Improvement in Renewable Energy Sources by Using Cups Fed by Solar Panels

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Abstract*:* A Power quality problem is an occurrence of nonstandard voltage, current or frequency that results in a failure or a disoperation of end user equipment's. Utility distribution networks, sensitive industrial loads and critical commercial operations suffer from various types of outages and service interruptions which can cost significant financial losses. With the increase in load demand, the Renewable Energy Sources (RES) are increasingly connected in the distribution systems which utilizes power electronic Converters/Inverters in cups (custom power devices). This paper presents novel power electronics for the integration of wind and photovoltaic (PV) control strategy for achieving maximum benefits from these grid interfacing inverters using cascaded current–voltage control strategy is proposed for inverters to simultaneously improve the power quality of the inverter local load voltage and the current exchanged with the grid.

Keywords: *Renewable Energy Sources, Converters/Inverters in cups, power quality, grid.*

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I INTRODUCTION

The power-electronic technology plays an important role in distributed generation and in integration of renewable energy sources into the electrical grid.To have sustainable growth and social progress, it **is** necessary to meet the energy need by utilizing the speed wind turbine operation, all the fluctuation in the renewable energy resources like wind, biomass, hydro, co- wind speed are transmitted as fluctuations in the generation, etc In sustainable energy system, energy mechanical torque, electrical power on the grid and leads conservation and the use of renewable source voltage fluctuations. During the normal operation, paradigm. The need to integrate the renewable energy like wind turbine produces continuous variable output wind energy into power system is to make it possible to power. These power variations are mainly caused by the minimize the environmental impact on conventional plant effect of turbulence, wind shear and tower-shadow [1]. The integration of wind energy into existing power control system in the power system. Thus, the network system presents a technical challenges and that requires needs to manage for such fluctuations. The power quality is an essential transmission and distribution network, such as voltage customer-focused measure and is greatly affected by the sag, swells, flickers, harmonics etc. However the wind operation of a distribution and transmission network. One of the simple methods of running a wind turbine [2]. There has been an extensive growth and generating system is to use the induction generator quick development in the exploitation of wind energy is connected directly to the grid system. The individual units can be of large capacity generator has inherent advantages of cost ,effectiveness and robustness. However; induction generators require reactive power for magnetization. When from the wind velocity and generator torque.

II. STATCOM

A STATCOM based control technology has been proposed for improving the power quality which can technically manages the power level associates with the commercial wind turbines. The proposed STATCOM control scheme for grid connected wind energy generation for power quality improvement has following objectives. Unity power factor at the source side. Reactive power support only from STATCOM to wind Generator and Load. Simple bang-bang controller for STATCOM to achieve fast dynamic response. The Increasing number of renewable energy sources and distributed generators requires new strategies for the operation and management of the electricity grid in order to maintain or even to improve the power-supply reliability and quality. In addition, liberalization of the grids leads to new management structures, in which trading of energy and power is becoming increasingly important and it is widely used and rapidly expanding as these applications become more integrated with the grid- based systems. Power electronics has undergone a fast evolution, which is mainly due to two factors. The first

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one is the development of fast semiconductor switches that are capable of switching quickly and handling high powers. The second factor is the introduction of real-time computer controllers that can implement advanced and complex control algorithms. These factors together have led to the development of cost-effective and grid-friendly converters. In this paper,new trends in power-electronic technology the renewable energy source. we describe the current technology and future trends in variable-speed wind turbines. Wind energy has been demonstrated to be both technically and economically viable. It is expected that current developments in gearless energy transmission with power-electronic grid interface will lead to a new generation of quiet, efficient, and economical wind turbines. we present power-conditioning systems used in grid-connected photovoltaic(PV) generation plants. The continuously decreasing in prices for the PV lead to the increasing importance of cost reduction of the specific PV converters. Energy storage in an electricity generation and supply system enables the decoupling of electricity generation from demand. In other words, the electricity that can be produced at times of either low-demand low-generation cost or from intermittent renewable energy sources is shifted in time for release at times of high-demand high-generation cost or when no other generation is available. Appropriate integration of renewable energy sources with storage systems allows for a greater market penetration and results in primary energy and emission savings. we present research and development trends in energy-storage systems used for the grid integration of intermittent renewable energy sources. Market Considerations Solar-electric-energy demand has grown consistently by 20%–25% per annum over the past 20 years,Which is mainly due to the decreasing costs and prices. This decline has been driven by

1) an increasing efficiency of solar cells;
2) manufacturing-technology improvements; and
3) economies of scale. In 2001, 350 MW of solar equipment was sold to add to the solar equipment already generating a clean energy. In 2003, 574 MW of PV was installed. This increased to 927 MW in 2004. The European Union is on track to fulfilling its own target of 3 GW of renewable electricity from PV sources for 2010, and in Japan, the target is 4.8 GW. If the growth rates of the installation of PV systems between 2001 and 2003 could be maintained in the next years, the target of the European Commission's White Paper for a Community Strategy and Action Plan on Renewable Sources of Energy would already be achieved in 2008. It is important to notice that the PV installation growth-rate curve in the European Union exactly mirrors that of wind power, with a delay of approximately 12 yearsconverter (with or without isolation). The isolation used in both categories is acquired using a transformer that can be placed on either the grid or LF side or on the HF side. The line-frequency transformer is an important component in the system due to its size, weight, and price. The HF transformer is more compact, but special attention must be paid to reduce losses . The use of a transformer leads to the necessary isolation (requirement in U.S.), and modern inverters tend to use an HF transformer. However, PV inverters with a dc/dc converter without isolation are usually implemented in some countries where grid-isolation is not mandatory. Basic designs focused on solutions for HF dc/dc converter topologies with isolation such as full-bridge or single-inductor push–pull permit to reduce the transformer ratio providing a higher efficiency together with a smoother input current. However, a transformer with tap point is required. In addition, a double-inductor push–pull is implemented in other kind of applications (equivalent with two interleaved boost converters leading to a lower ripple in the input current), but extra inductor is needed. A full-bridge converter is usually used at power levels above 750 W due to its good transformer utilization. Another possible classification of PV inverter topologies can be based on the number of cascade power processing stages. The single- stage inverter must handle all tasks such as maximum- power-point-tracking control, grid-current control, and voltage amplification. This configuration, which is useful for a centralized inverter, has some drawbacks because it must be designed to achieve a peak power of twice the nominal power. Another possibility is to use a dual-stage inverter. In this case, the dc/dc converter performs the MPPT (and perhaps voltage amplification), and the dc/ac inverter is dedicated to control the grid current by means of pulse width modulation (PWM), space vector modulation (SVM), or bang–bang operation. Finally, multistage inverters can be used, as mentioned above. In this case, the task for each dc/dc converter is MPPT and, normally, the increase of the dc voltage. The dc/dc converters are connected to the dc link of a common dc/ac inverter, Variation: The voltage variation issue results variation is directly related to real and reactive power variations. The voltage variation is commonly classified as under: • Voltage Sag/Voltage Dips. • Voltage Swells. • Short Interruptions. • Long duration voltage variation.

The voltage flicker issue describes dynamic variations in the network caused by wind turbine or by varying loads. Thus the power fluctuation from wind turbine occurs during continuous operation. The amplitude of voltage fluctuation depends on grid strength, network impedance and phase- angle and power factor of the wind turbines. It is defined as a fluctuation of voltage in a frequency 10–35 Hz. The harmonic results due to the operation of power electronic converters. The harmonic voltage and current should be limited to the acceptable level at the point of wind turbine connection to the network. To ensure the harmonic voltage within limit, each source of harmonic current can allow only a limited contribution. The rapid switching gives a large reduction in lower order harmonic current compared to the line commutated converter, but the output current will have high frequency current and can be easily filter-out. Wind Turbine Location in Power System: The way of connecting the wind generating system into the power system highly influences the power quality. Thus the operation and its influence on power system depend on the structure of the adjoining power network. Self Excitation of Wind Turbine Generating System: The self excitation of wind turbine generating system with an asynchronous generator takes place after disconnection of wind turbine generating system With local load. The risk of self excitation arises especially when WTGS is equipped with compensating capacitor. The capacitor connected to induction generator provides reactive power compensation. However the voltage and frequency are determined by the balancing of the system. The disadvantages of self excitation are the safety aspect and balance between real and reactive power

III. GRID COORDINATION RULE

The interconnection of wind plants to the utility systems, after the block out in United State in August 2003.According to these, operator of transmission grid is responsible for the organization and operation of interconnected system.

1) Voltage rise (u) The voltage rise at the point of common coupling can be approximated as a function of maximum apparent power Smax of the turbine, the grid impedances R and X at the point of common coupling and the phase angle , given in Eq. 1

$$\Delta\mu = \frac{S_{max}(B\cos\phi - X\sin\phi)}{U^2} \qquad (1)$$

Where —Δμ -voltage rise,
S max —max. Apparent power,
Φ—phase difference,
U—nominal voltage of grid.
The Limiting voltage rise value is less.
2) Voltage dips (d) the voltage dips is due to startup of wind turbine and it causes a sudden reduction of voltage. It is the relative % voltage change due to switching operation of wind turbine.

The decrease of nominal voltage change is given in Eq. 2.

$$D = Ku\ sn/sk \qquad (2)$$

Where d is relative voltage change, sn is rated apparent power, sk is short circuit apparent power, and Ku is sudden voltage reduction factor. The acceptable voltage dips limiting value is<3%.
3) Harmonics The harmonic distortion is assessed for variable speed turbine with a electronic power converter at the point of common connection.
4) GRID FREQUENCY The grid frequency in India is specified in the range of 47.5–51.5 Hz, for wind farm connection.

VI. TOPOLOGY FOR POWER QUALITY IMPROVEMENT

The STATCOM based current control voltage source inverter injects the current into the grid will cancel out the reactive part and harmonic part of the load and induction generator current, thus it improves the power factor and the power quality. To accomplish these goals, the grid voltages are sensed and are synchronized in generating the current. The proposed grid connected system is implemented for power quality improvement at point of common coupling (PCC), for grid connected system

V. WIND ENERGY GENERATING SYSTEM

In this configuration, wind generations are based on constant speed topologies with pitch control turbine The induction generator is used in the proposed scheme because of its simplicity, it does not require a separate field circuit, it can accept constant and variable loads, and has natural protection against short circuit.

VI. SYSTEM PERFORMANCE

The proposed control scheme is simulated using SIMULINK in power system block set. The system parameter for given system .The system performance of proposed system under dynamic condition is also presented. A. Voltage Source Current Control—Inverter Operation the three phase injected current into the grid from STATCOM will cancel out the distortion caused by the nonlinear load and wind generator. The IGBT based three-phase inverter is connected to grid through the transformer. The generation of switching signals from reference current is simulated within hysteresis band of 0.08. The choice of narrow hysteresis band switching in the system improves the current quality. The control signal of switching frequency within its operating band, as shown in Fig.1

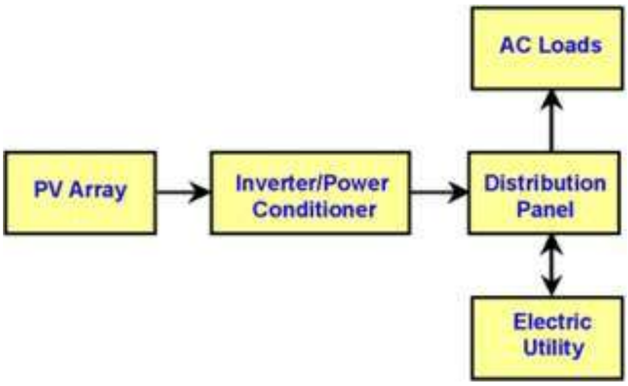

Fig 1: Frequency operating band.

VII. CONCLUSION

The paper presents the STATCOM-based control scheme for power quality improvement in grid connected wind generating system and with nonlinear load. The power quality issues and its consequences on the consumer and electric utility are presented. The operation of the control system developed for the STATCOM-BESS in MATLAB/SIMULINK for maintaining the power quality is simulated. It has a capability to cancel out the harmonic parts of the load current. It maintains the source voltage and current in-phase and support the reactive power demand for the wind generator and load at PCC in the grid system, thus it gives an opportunity to enhance the utilization factor of transmission line. The integrated wind generation and STATCOM with BESS have shown the outstanding performance.

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